JOREK simulations of Shattered Pellet Injection with high Z impurities

D. Hu[1], E.Nardon[2], G.T.A. Huijsmans[1,2], M. Lehnen[1].

[1] *ITER Organization, Route de Vinon sur Verdon, 13115 Saint Paul Lez Durance, France*

[2] *CEA, IRFM, F-13108 Saint-Paul-Lez-Durance, France*

The effect of Shattered Pellet Injection (SPI) using pure impurity pellets on the electron density and MHD modes is studied in the reduced MHD model of the JOREK code with a JET L-mode equilibrium as the target plasma and an injection configuration resembling that of the upcoming JET SPI system [1]. The pellet fragment ablation is described by considering the Neutral Gas Shielding (NGS) model for each fragment [2], and the fragment size distribution is set according to the Statistical Fragmentation Model [3]. The momentum transfer between the neutrals and the ionised plasma due to charge-exchange is assumed to be frequent enough so that the neutrals are convected along with the plasma flow. A simplified model based on coronal-equilibrium is used for the impurity radiation function, which, despite the fact that the plasma is not really in coronal-equilibrium, results in only small deviation from more detailed analysis so long as the plasma is cooled down fast enough.

The impact of local radiation cooling at the rational surfaces as well as the global current contraction are investigated and their impact on MHD instability will be discussed. The MHD spectrum excited by the impurity SPI is qualitatively compared with that of the deuterium one for which only dilution cooling is present. The difference in injection penetration and assimilation as a result of the difference in MHD activity will be compared. Also, the radiation asymmetry of SPI is investigated and compared to that of a Massive Gas Injection (MGI) case.

Furthermore, the impact of injection parameters such as the injection velocity and the characteristic fragment size on the penetration and assimilation is demonstrated by varying the injection parameters. The effect of SPI for different target equilibria, such as those with different q profiles or pre-injection thermal energy, will also be discussed. Such analysis will provide insight for the preferable SPI parameters for the future ITER disruption mitigation system.

References

[1] L. Baylor, “Developments in Shattered Pellet Technology and Implementation on JET and ITER”, PPPL TSD workshop report, 2017. (http://tsdw.pppl.gov/Talks/2017/Lexar/Monday%20Session%201/Baylor.pdf)

[2] V. Yu. Sergeev, O. A. Bakhareva, B. V. Kuteev and M. Tendler, Plasma Phys. Rep. Vol. **32**, No. 5, 363 (2006);

[3] P. Parks, “Modeling Dynamic Fracture of Cryogenic Pellets”, GA report GA-A28352, 2016. (https://www.osti.gov/scitech/servlets/purl/1344852)